

WEB-BASED GIS APPLICATION FOR LOCATING SCHOOLS FOR ADMISSION OF CHILDREN TO GRADE ONE

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ABSTRACT: Admitting a child into Grade One of government or private school has become a traumatic and unpleasant event in Sri Lanka. An automated system of web based GIS application will prevent the bias and subjectivity related to Grade One admission to popular schools. Generally, students are admitted to popular schools based on the distance to the school from students' home in Sri Lanka. Location is geographical information that could be displayed using Geographical Information System (GIS). Web GIS is an advanced technology to manage and display all geographical locations on the earth's surface. Thus, aim of the present study is to present a web-based application for determining the distance to the residence of an applicant to nearby schools. The study area was Kandy Educational Zone, Kandy District, in Central Province. The application was developed by incorporating GIS for the location detection and analysis. Web mapping application was developed by using different free and Open Source software tools which are low cost, high stable and secure. Web-GIS architecture was implemented using open source Web-GIS tools like Opegeo suite, GeoServer, PostgreSQL, PostGIS, OpenLayers, GeoExt and Ext JS. The created system is user friendly and the user can click their home location on the map to see a radius of 3 kilometers buffer/circle (this default distance can be changed) and identify the schools to which they are eligible for grade one admission. This application could be extended to all the educational zones in Sri Lanka as this would be much beneficial to all parents who are aspiring to seek admission of their children to popular schools. Further, this will be a valuable application for the officials served in Grade one selection panels for popular schools.

1. INTRODUCTION

1.1 General Introduction: The Central Province has been divided into 15 Educational Zones and 44 Divisions. There is a total of 1,513 schools in the entire province composed of 108 1AB, 326 1C, 491 Type 2 and 588 Type 3 schools. There is a total of 526,157 students and 31,674 teachers in the province with a Student Teacher Ratio of 17. The focus for this research is the Kandy Educational Zone.

Every year, on an average of 45,561 students enter the grade one classes in Central Province. There are 8212 students entering from the Kandy Educational Zone. The aspiration of the parents is to admit the child to a popular school in the town. There are a limited number of seats in the popular schools and this makes the parents to involve in unethical activities, violating the circulars to admit their children to the so called "Popular Schools". This present study is a proposal to design and build a web-based GIS application to help the parents/ legal guardian who expect to admit their children to grade one in popular schools based on distance (category of children residents in close proximity to the school). Moreover, it is to create an application that allows parents to input the information on location of their residence by clicking on the map via a web interface and to receive an automated map on which schools within a given distance around their residence which is a major criteria for admission.

A major problem facing the development of Geographic Information System (GIS) in the Sri Lankan education sector is the limitation of budget. High technology cost of the necessary software in developing countries like Sri Lanka is a problem. As a result, Free and Open Source GIS applications were used for this project.

1.2 Problem Statement: Admitting a child into Grade One of government or private school has become a traumatic and unpleasant event. There is a competition among the parents in Sri Lanka to admit their children to popular schools. Hence, Parents tend to sort unethical and unacceptable means to find a better school for their child. Sometimes they tend to try even illegal ways for this purpose. Sometimes children are being coached to lie about their resident. The problem which was originally concentrated in government schools. They have now reached crisis proportions even in private schools.

The parents also face difficulty in making a decision whether to make an application to a particular school since they are not certain about distances to the schools around their residence. However, many parents are unaware of

the procedures and hopelessly try various means spending much time and money ultimately leading to frustration with the denial of admission.

Therefore, an automated system of web based GIS application will prevent the bias and subjectivity related to Grade One admission to popular schools. Further, this system will be transparent, accurate and taking quick decisions. The errors created by manual calculations practiced currently by Sri Lankan school authorities and officers can be minimized by using this automated web application.

The increased demand is not for all schools, but for popular national schools. There is an ongoing process of consolidation whereby a small number of schools are becoming bigger schools with enrollments in excess of 2000, while demand is dropping fast for small schools within their catchment areas.

This report presents a web-based application for determining the distance to the residence of an applicant to nearby provincial and national schools. The application is developed by incorporating GIS for the location detection and analysis.

1.3 Objectives of the Project: The present study is mainly focused on the following objectives:

- To create a web GIS application that allows parents to provide by clicking the point on the provided map on the web or by entering the coordinates of their location via a web interface and receive automated map plot of their location and criteria based result.
- To make parents take quick decisions regarding the eligibility of their child to the popular schools.
- To reveal the accuracy of applied Grade One admission criteria.
- To maintain transparency of the process.

2. LITERATURE REVIEW

The Grade one admission has become one of the major issues in Sri Lankan education system. Ministry of Education issues circulars with stipulated rules and regulations and these circulars are amended with demand and time. The free and open source software (FOSS) has been used to create a web GIS application that allows parents to know the procedures on a distance which is a main criteria on the admission circulars and they will be able to provide by clicking the point on the provided map on the web or by entering the coordinates of their location via a web interface and receive automated map plot of their location and criteria based result.

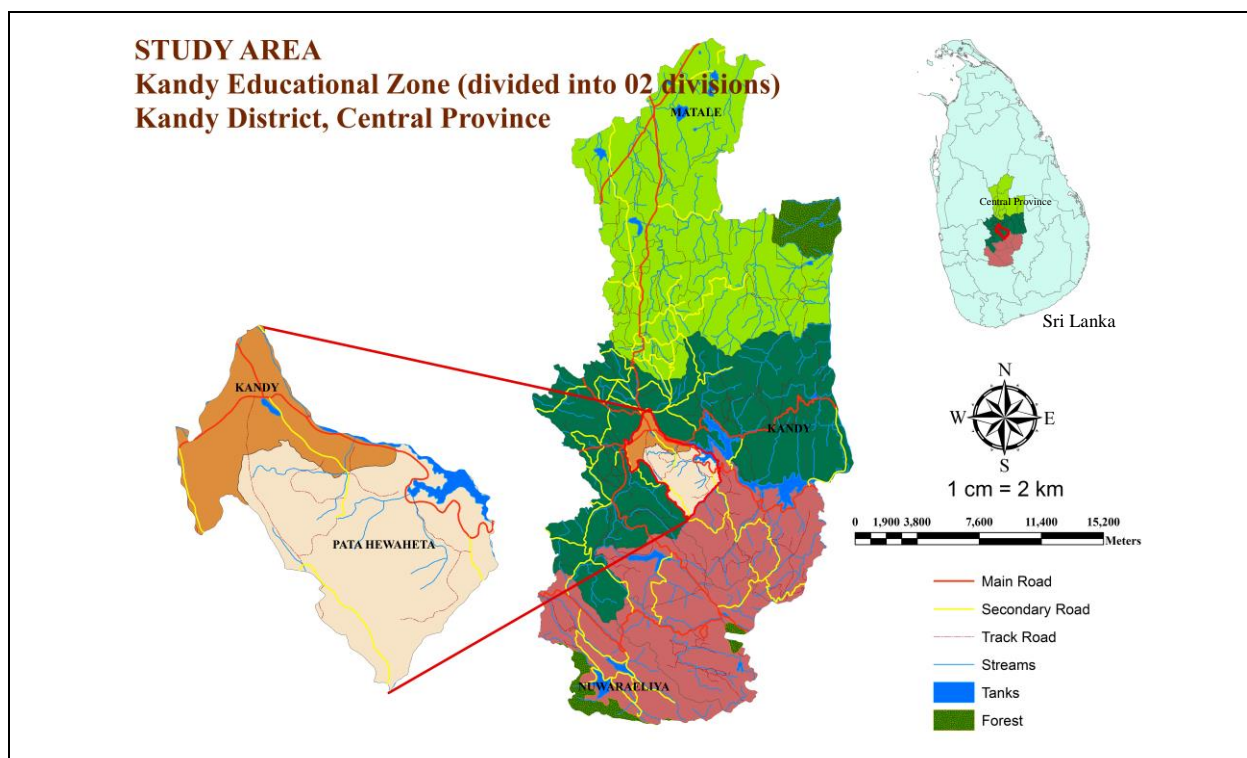


Figure 2.1: The study area of Kandy educational zone

2.1 Study Area: Figure 2.1 shows the study area as a Kandy Educational Zone in Central Province, Sri Lanka. The Kandy Educational Zone has been divided into 02 divisions. The data in this research are collected from these 02 divisions. There is a total of 114 schools in the entire zone composed of 21 1AB, 28 1C, 44 Type 2 and

21 Type 3 schools, comprising of 87,437 students and 4,646 teachers with a student teacher ratio of 18. There are 9 popular National Schools. As a sample the zone is selected as it is the popular zone in the Central Province, which has many issues pertaining to Grade One admission.

Kandy Educational Zone, Kandy District, Central Province was chosen as the area for testing purposes. This application could be extended to all the zones in Sri Lanka as this would be much beneficial to all parents who are aspiring to seek admission of their children to popular schools. Further, this will be a valuable application for the Sri Lankan officials involved in Grade One admission to popular schools.

3. METHODOLOGY

Overall development is carried out in several phases (Three-Tier Architecture) as listed below.

- Bottom Tier - Database design
- Middle Tier - Adding database into Geoserver
- Top Tier - Web page design

The above sections are described in detail.

Figure 3.1 shows the methodology adopted for making the system architecture for the WEB-GIS. The system shall have a web map element, a middleware and a spatial database. The web map component allows access to the data with simply an online web browser. The middleware delivers data from the database and applies styling rules and outputs map images. This also provides the programming framework for custom applications. The spatial database runs random access to large data sets, query processing that recognizes spatial relationships, and transactional integrity during synchronized editing. Open-source programs which link to each component in the system architecture are utilized. The web map component used is GeoExt with OpenLayers, a spatial data viewer. The middleware is the Opende suite - GeoServer, associate application server. Finally the spatial database used is that the PostGIS. The utilization of those programs foregoes high development costs.

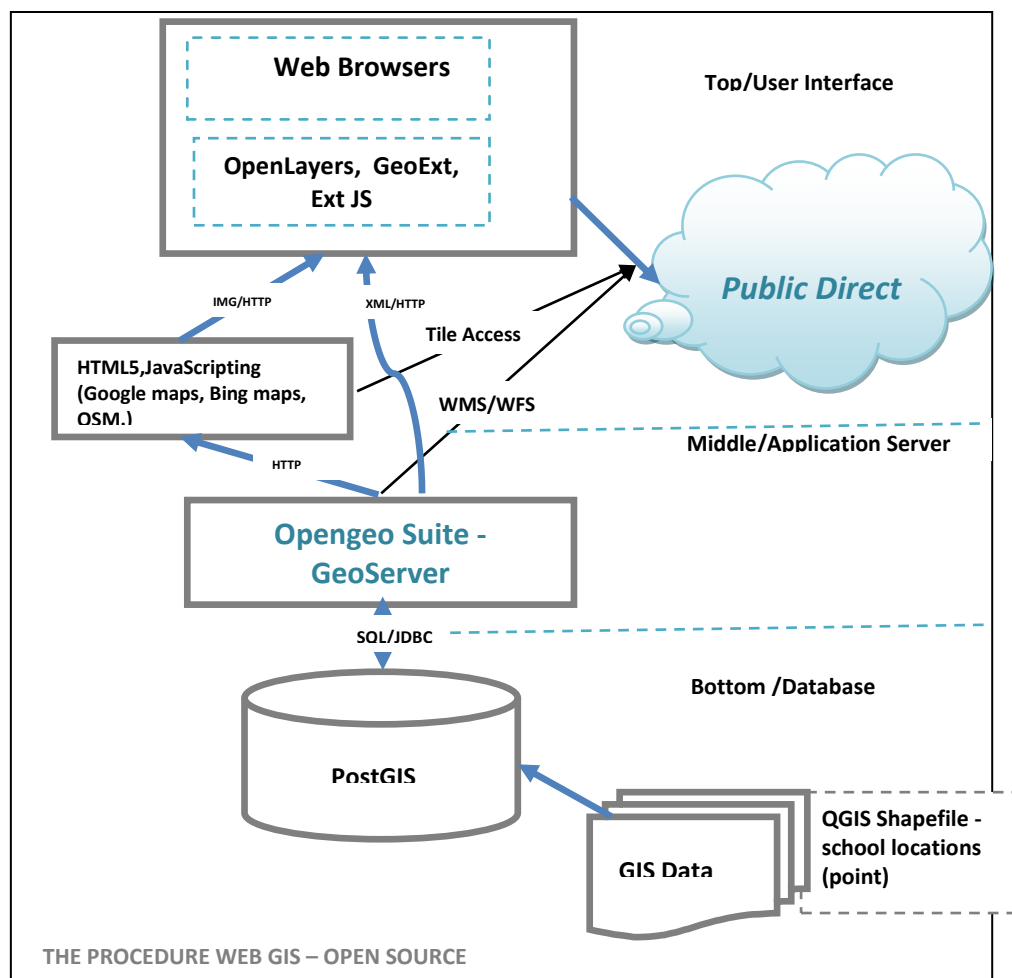


Figure 3.1: Methodology

4. RESULTS AND DISCUSSION

Kandy zonal schools were taken as a sample for testing the new web GIS application development. Any interested person who is interested about marks that an applicant would score for the admission to Grade One popular national school can access the details using the developed web GIS application.

Although, Kandy Zone was taken as a sample, this application can be used in any zone in Sri Lanka for the same purpose.

For an example, a parent from a residence located at 7.273377N, 80.658848E coordinates Ampitiya in Kandy Zone, seeks admission for a daughter to grade one Sinhala medium in one of the popular schools in the Kandy Zone as shown in Figure 4.1.

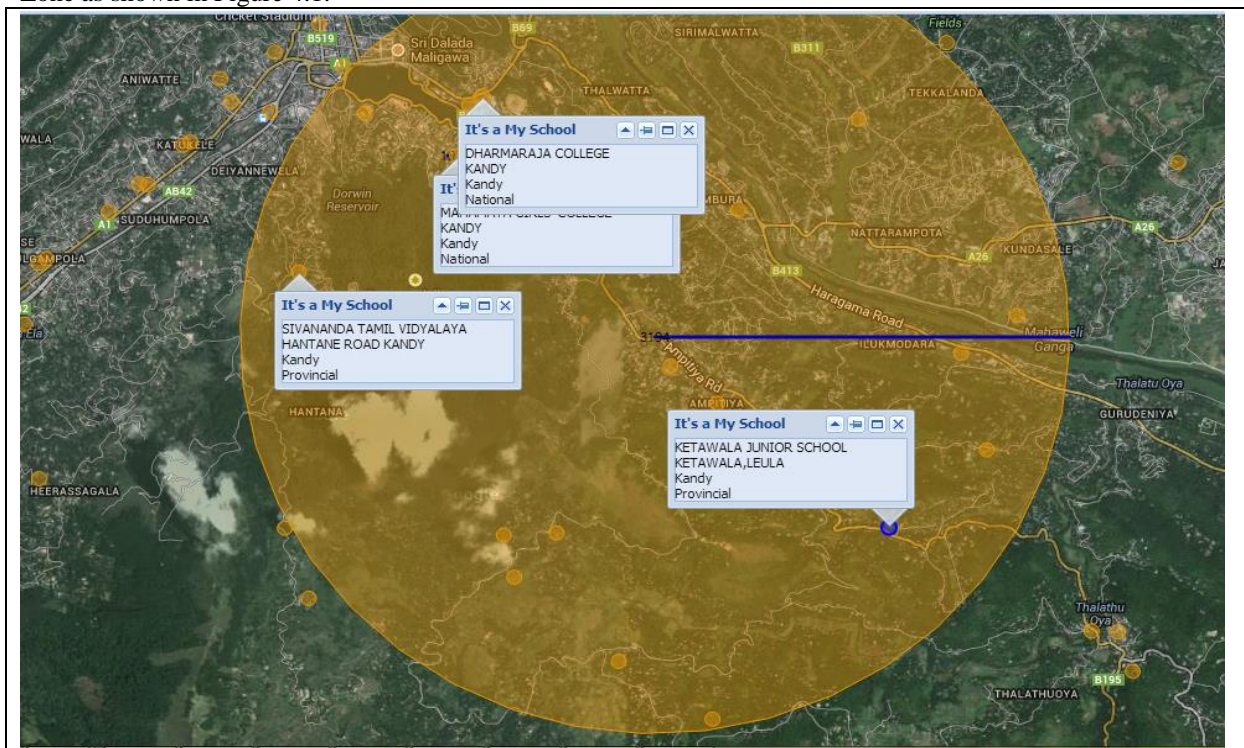


Figure 4.1: Applicant click on home location and generate a circle of 3000 m radius.

The possible schools within the buffer zone of 3000 meters radius from their residence of the applicant that matches with the required criteria are shown in Table 4.1.

Table 4.1: The feasible schools within the buffer zone of 3000 m radius.

School Name	Address	Type	Medium	Gender	Grade Span	Marks
Dharmaraja College	Kandy	National (Popular)	S	Boys school	13-Jan	
Ketawala Junior School	Ketawala, Lewula	Provincial	S	Mix school	5-Jan	-5
Sivananda Tamil Vidyalaya	Hewahata Road, Kandy	Provincial	T	Mix school	5-Jan	
Sidhartha M.V	Ampitiya	Provincial	S	Mix school	13-Jan	-5
Berawards College	Ampitiya	Provincial	S	Mix school	13-Jan	-5
Mahamaya Girl's College	Kandy	National (Popular)	S	Girls school	13-Jan	
Maximum Marks						35/50

Most appropriate popular school that matches the particular location and the given criteria is Mahamaya Girl's College and it is justified by criteria (6.1- Children of residents in close proximity to the school) specified in the circular of Grade One admission. Detailed procedures are given below.

4.1 Web Based Interface: The web base interface is the initial page of the application, which is accessed by the client through a call of HTML page of the local server. The Web-based GIS application developed for grade one admission in popular schools was run on a local server. (http://localhost:8080/geoserver/www/gradeone_web/index.html) Local server was a normal laptop with Intel (R) Core (TM) i3-2350M processor, 4GB RAM, 500GB storage capacity of the hard disk.

4.2 Testing The Application On Web Browsers: This application was accessed via several web browsers to test the compatibility. As a result of these tests, it was found that Google Chrome and Mozilla Firefox Web browsers were the best of all. An output of a test run of the GIS application using Google Chrome browser is shown in the Figure 4.2.

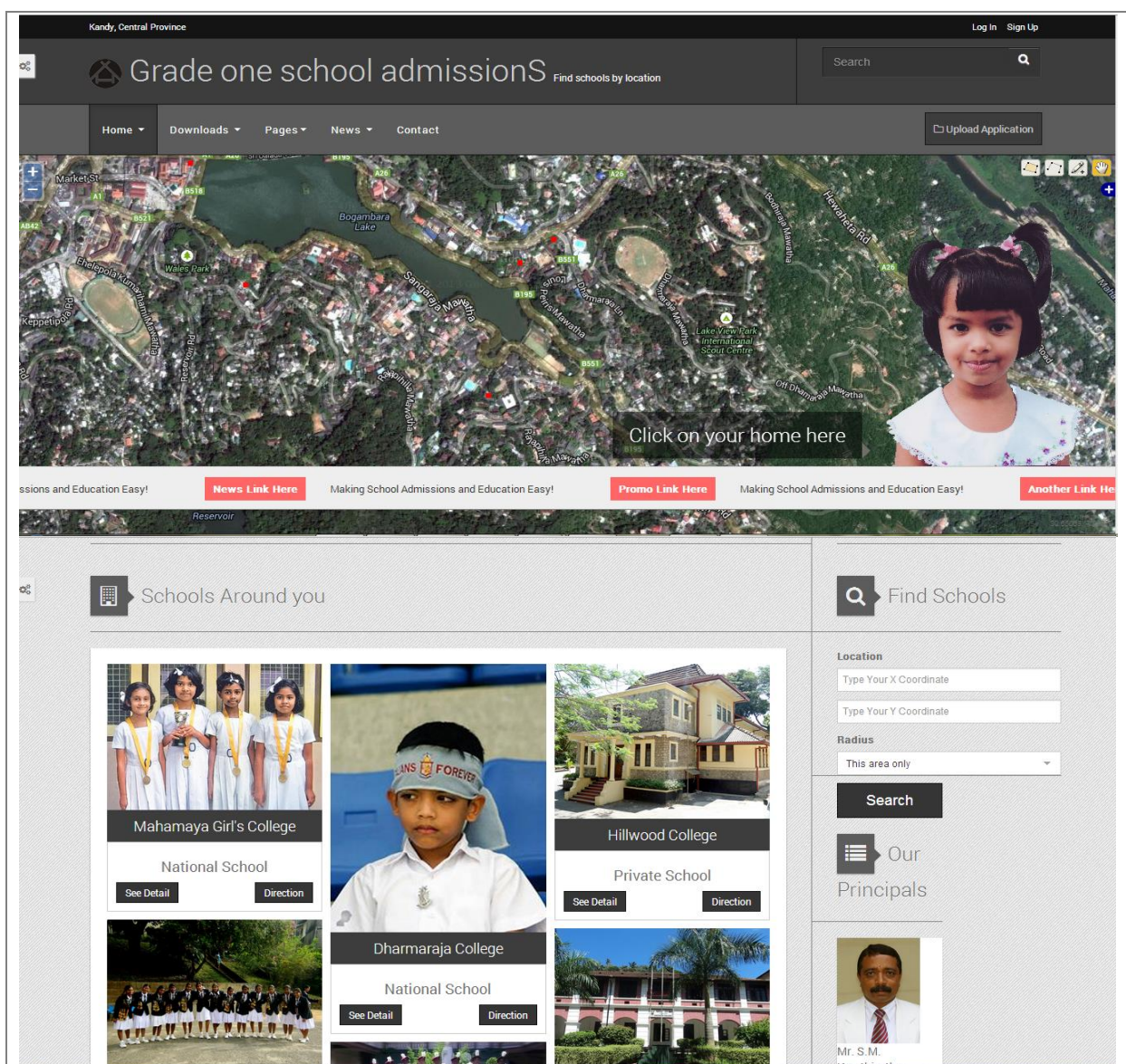


Figure 4.2: Web GIS Application interface of Kandy zone

As shown in the Figure 4.2, Google map base layer was zoomed and centered in the study area of Kandy Educational Zone. On top of a base layer, a layer showing school locations (points in red color), and a layer displaying tree items (styled according to tree types) were overlaid with the help of OpenLayers as a third party client. The middleware reads data from the database and applies styling rules and output map images. The layer

data were stored and retrieved from a PostgreSQL database, styled by GeoServer. Google Map API provides several standard out-of-the-box web mapping tools, which were listed and explained in Table 4.2.

Table 4.2: Out-of-the-box web mapping tools – Google Maps

Web mapping application tools	Description
Navigation tools	Allows a) Zoom In/Out b) Pan c) Full extent d) Overview map
Map element	Google, Bing API and OSM allow Google, Bing, OSM maps as data source
Map type control	Allows users to switch between normal maps, satellite images and hybrid maps etc.,
Scale bar	Allows dynamic scale bar on Google maps

The final Web-GIS Application consists of the above pages. Home page: This is generally the page through which users/visitors will enter our site. The web interface consists of an embedded map component with buffer analysis and includes the main navigation links to the other pages within our site. Downloads page: User can download the admission of grade one circulars in pdf format and About page, Gallery, News, Contact us page. On the bottom right, the buttons have been created to assist the end user to perform specific operations. The details of the buttons are: Text box1 to type user X coordinate, Text box2 to type user Y coordinate, Radius Text box - To type the value for radius and search button to find locations.

4.3 Visualization of School Locations: As shown in the Figure 4.3, The layer toggle is located on the upper right-hand side. The toggle allows choosing the map background between Bing, OSM and Google Maps. A base layer is at the very bottom of the layer list, and all other layers are on top of it. The order of the other layers can change, but the base layer is always below the overlay layers. By default, the first layer that we add to our map acts as the base layer. We have multiple base layers here. (Google Physical, Google Streets, Google Hybrid, Google Satellite, Bing layers and Openstreet) However, only one base layer can be active at a time. When one base layer is turned on, all the other base layers are turned off. Overlay layers (school locations_kandy and Editable Vectors), however, do not behave this way - turning on or off overlay layers will not affect other overlay layers. Base layers are similar to radio buttons - only one can be active at a time. Overlay layers are similar to check boxes - we can have as many on or off as we would like.

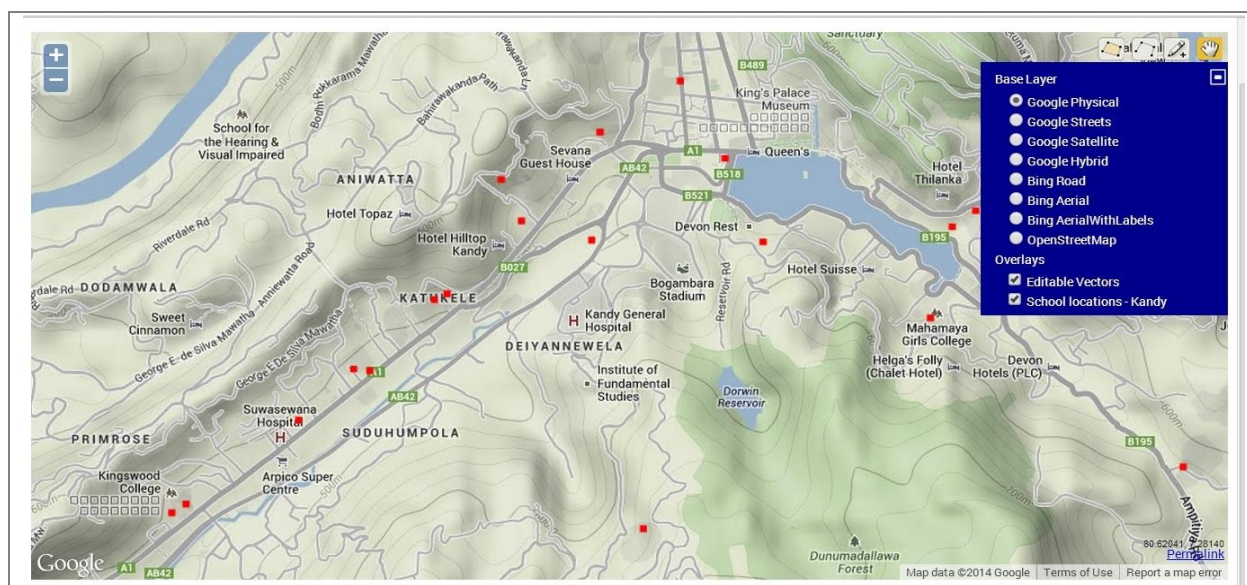


Figure 4.3: Screenshot showing school locations in WMS layer overlaid with online base layers (Google/Bing/Open street)

It is essential for mapping applications provide a user with navigation tools. The present web GIS application allows the user to move the map using pan tool and Panning arrows move the map in a needed direction as well. There are several options of changing the map zoom: by clicking on the + or – buttons, double clicking on the

map and moving the mouse scrolling wheel. Draw a point, line, polygon with the pan tool displayed in the upper right corner of the map.

4.4. Visualization of The School Attribute Information: The user can click any of the schools which get highlighted or on mouse over and displays the information on mouse click on the school. This functionality is demonstrated in Figure 4.4.

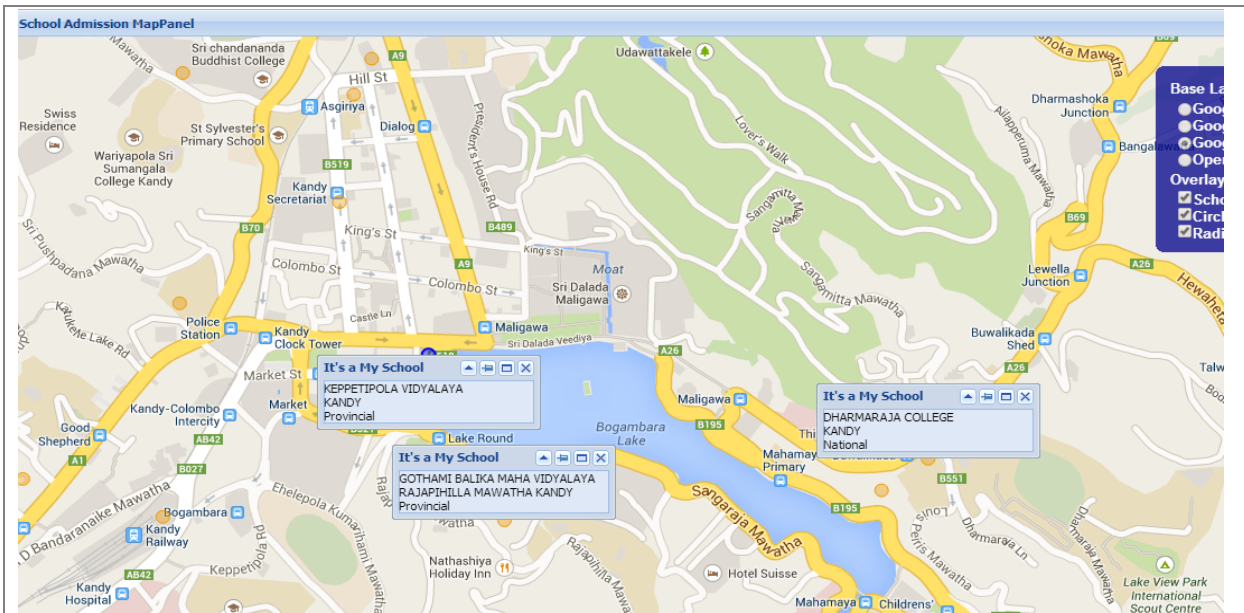


Figure 4.4: Screenshot of school locations overlaid with a base layer and their attribute information

The projected school location data set via GeoServer is added as a separate overlay layer in the form of WFS. After the data set is displayed, a user can get attribute information on every point feature with a popup window. It provides all corresponding information related to the selected point feature.

As shown Figure 4.4, the current functionality visualizes the school name, address and the school type. As per requirement, more details can be added to be displayed.

4.5 Obtaining Coordinates: User can get the longitude and latitude coordinates of a clicked point is placed on a map (their home location or any search location) as an alert message.

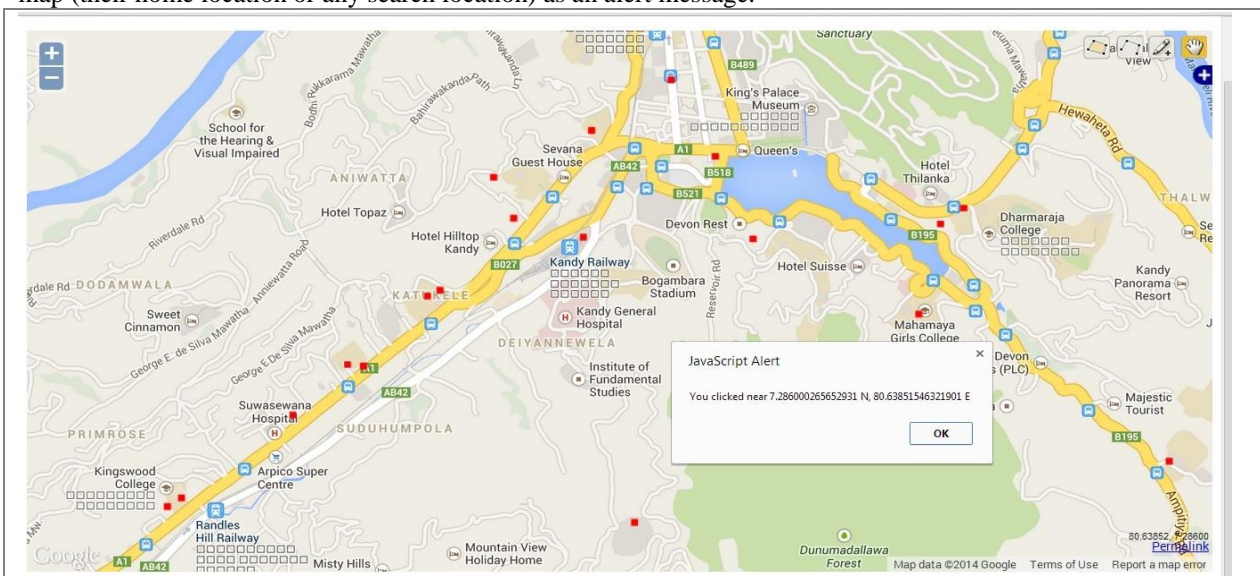


Figure 4.5: Obtaining the longitude and latitude coordinates

4.6 Creation of A Circle With A Given Radius: A new feature of the site is for an applicant/user to be able to draw a circle on the study area of the Kandy Zonal map. OpenLayers allow for drawing circles using any user planar distances and print the intersection result of schools. In the Figure 4.7 below the circle planar radius is 3000 meters.

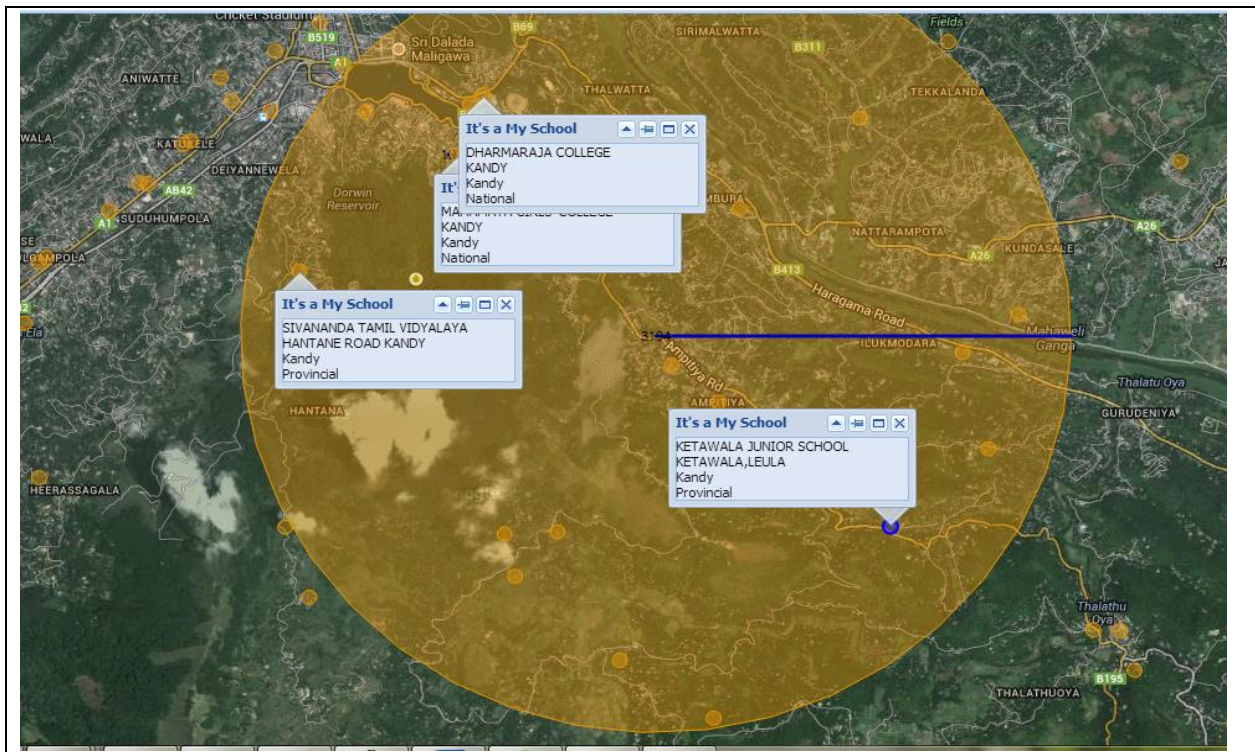


Figure 4.6: Click on a home location and generate a circle

User Clicks on a user's home location and generate a circle with radius of the given distance (user can change this distance) around the point clicked. The circle is generated on client side and is then used to query points that represent school locations in the buffered area. When clicked on a point to see more information about the school, there appears a pop-up window with information of schools within intersects area. (school name, schooltype, student total, teacher total etc.,).

The application output as per the criteria in details of the search. In example, schools within 3000 meters radius around the selected point on the map are displayed in the output.

- Zoom and Pan to find the required area on the map then click on the map (applicant home location) to draw a circle or type a location and radius into the text boxes and click search button to find schools in buffer zone or Input the latitude and longitude of the location in decimal format.
- Click as many times as necessary to draw multiple circles.
- The applicant can use the *Clear Map* button to erase all markers and radii and start again.

To show the distance measured, simply click once on one point, then move and click again on the second point. The radius distance of the circle should then be displayed and measure distances in meters. User can also adjust the radius distance of the circle.

4.7 Other Interactive Web Based Gis Utilities: The interactive map utilizes an interactive web-based GIS utility. With it, users are able to zoom and pan around the area, turn on and off different layers of interest and click on individual layers to obtain associated data. This map allows the user to click on the feature to display a popup window with school information and a html link to more information about the school as shown in Figure 4.7.

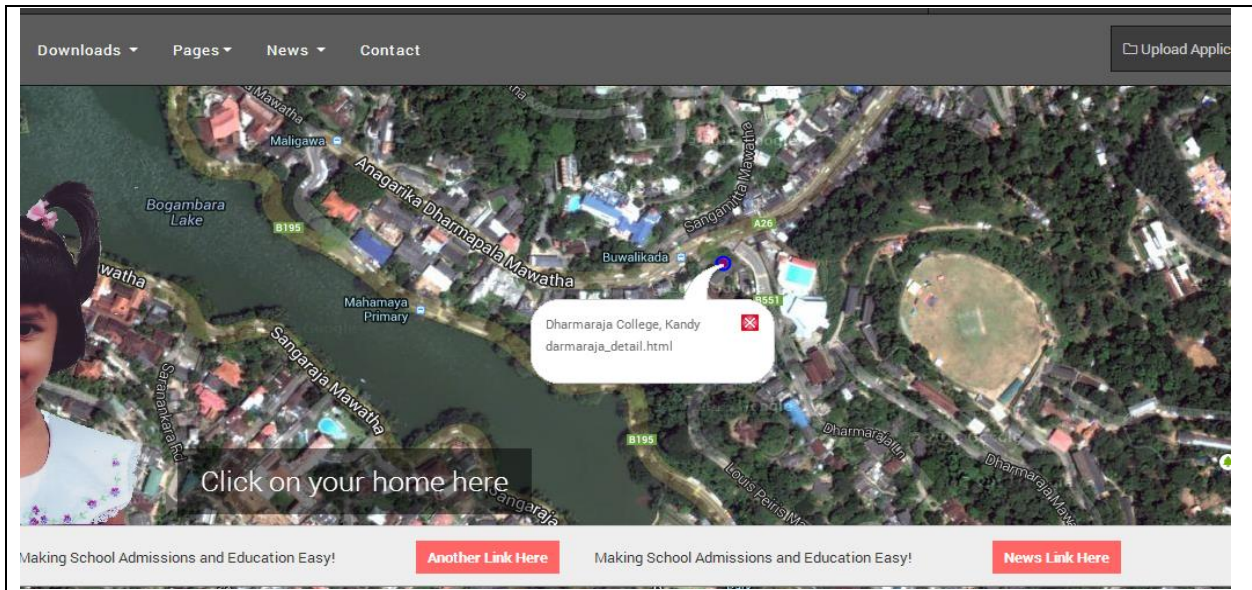


Figure 4.7: An interactive web-based GIS utility - Display a popup window with school information and a link

The user can measure the distance between two locations using Google Maps here. User can use a directions search button to get the walking or driving distance between two locations on the map. (home location to school location) A blue path will appear on the map between the two locations, and the distance will be shown in the left panel as shown in Figure 4.8.

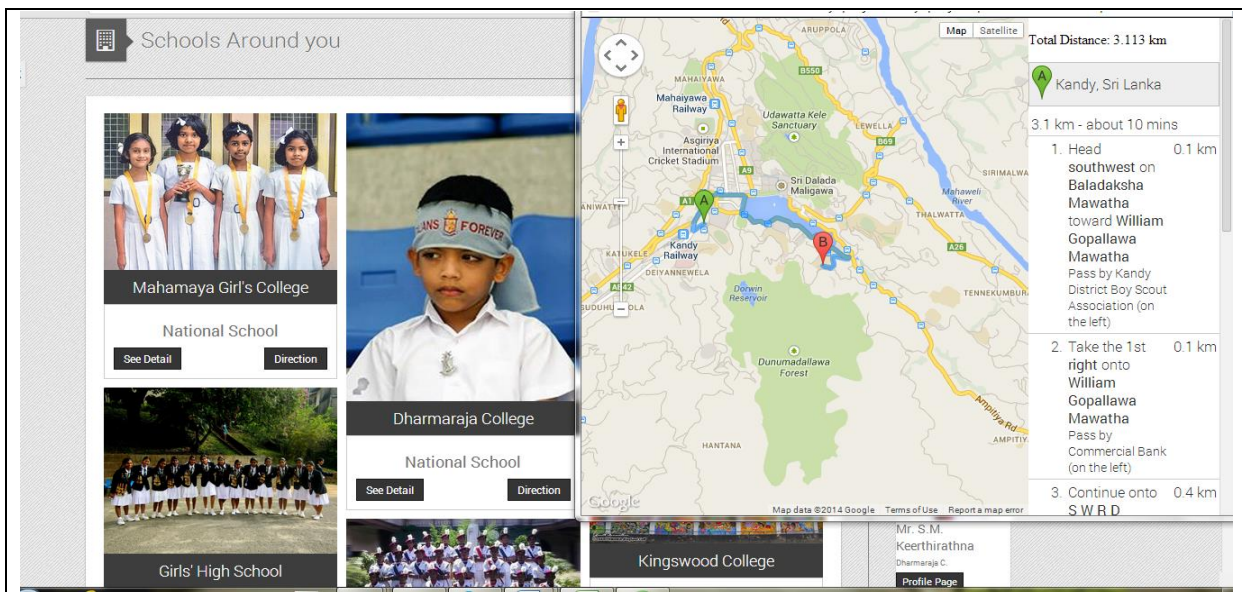


Figure 4.8: An interactive web-based GIS utility - measure the distance between two locations

The users will be able to get details of accessible schools and would be able to identify whether there is a possibility of admission to the desired popular schools. To a certain extent this will relieve the psychological stress of the parents.

The officers can make a justifiable decision with evidence based data than the manual calculation which creates in anomalies and issues.

5.1 CONCLUSIONS: The developed GIS application has specific features such as:

- Becoming more closer to the general public.

- Support sharing GIS application over the web so that different parties (all parents who are aspiring to seek admission to popular schools / officials involved in Grade one admission to popular schools) can access the information irrespective of the location.
- Supporting to decision making ability for stakeholders.
- Currently the parents face enormous problems regarding grade one admission to popular schools and the creation of the visual interaction with spatial data via the web GIS application would provide answers to some of their uncertainties especially regarding the distance which is a main criteria in grade one admission.
- Through the development of web GIS application, parents can obtain information and can make a quick decision on the eligibility of their child to the grade one admission without engaging in undue procedures as appeal boards.
- Every parent will be able to know the procedure as well as the marks their child can score as it is transparent. It will reduce the doubts, misunderstandings, misconceptions of admission processes. Further, parents will not have unnecessary tensions and aspirations as they will be aware about the possibility of admitting their child to a certain school based on accurate data.
- The parents will not involve in unethical and unacceptable interferences when they clearly understand the procedures and their positions in the admission criteria through the web interface. They will realize that immoral means will not help them since it can be challenged by deserving parents.

This project provides an example where OpenGeo Suite with GeoServer, PostgreSQL, PostGIS, GeoExt and OpenLayers and other open source software are used to publish geographic information, verifying the technical possibility of the using of open source software to publish spatial geographical information.

During this study, the use of Open Source software, powerful and technologically advanced, Open Source codes have been explored in order to create, analyze, implement and maintain a fully featured web GIS, which has a large number of characteristics with that provide low cost solutions for web publishing of geographic information. Further, it can successfully replace the commercial GIS software for web GIS projects.

The system developed with Open Source software is very suitable for organizations that have limited financial resources for spatial data sharing among the stakeholders.

5.2 RECOMMENDATIONS: The study was limited to Kandy Education Zone. It is recommended a Web GIS application to be extended to all the zones in Sri Lanka would be much advantageous to all parents who are ambitious to seek admission of their children to popular schools.

This Web GIS Application is recommended to be used by the officials involved in grade one admission to popular schools to take a fair and accurate decision in grade one admission and appeal procedures.

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